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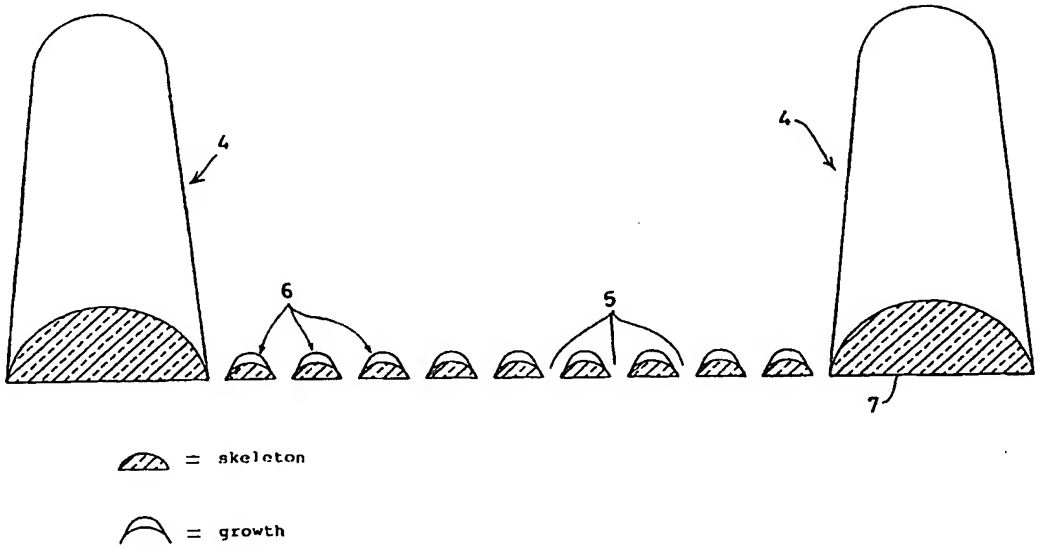
(54) Title: METHOD OF MANUFACTURING A SCREEN PRODUCT, A SKELETON FOR USE IN THE METHOD, AND A PRODUCT OBTAINED IN THIS WAY



(57) Abstract

The invention provides a method of manufacturing a screen product (1) having a screen pattern (2) of openings (5) separated by dykes (6) by causing a previously formed, electrically conducting initial skeleton (7) to grow by means of metal deposition in an electrolysis bath containing a brightener, with exposure of the initial skeleton (7) to incident flow. Surprisingly, it has been found that, if, prior to being caused to grow, the initial skeleton (7) is such that, or is arranged so that, during the growth, the flow through the initial skeleton (7) is locally blocked, the growth of metal takes place more quickly at said locations than the metal growth at those locations where the flow is unimpeded. Screen products can thus be manufactured having a great fineness, small openings and adequate strength. The invention also provides a skeleton for use in the above method and a product which comprises such a skeleton.

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Method of manufacturing a screen product, a skeleton for use in the method, and a product obtained in this way

The present invention relates to a method of manufacturing a screen product having a screen pattern of openings separated by dykes (sometimes called lands) by causing a previously formed, electrically conducting initial skeleton to grow by means of metal deposition in an electrolysis bath containing a brightener, with exposure of the initial skeleton to incident flow, as well as to a skeleton for use in such a method and a product thus obtained.

A method of the type described above is known, for example, from European Patent Application EP-A1-0 164 149. Said publication discloses a screen for screen printing which comprises a screen skeleton in the form of a fine gauze and a further metal layer electrolytically deposited thereon. Said screen has a fineness of between 250 and 1000 mesh (number of openings per linear inch).

It has, however, been found in practice that it was not possible to grow screens having high mesh values (fineness in the region of 250-1000 mesh) to adequate thickness (i.e. with adequate strength) while retaining adequate throughflow.

The object of the present invention is to manufacture screen products having adequate thickness (strength), high mesh value and adequate throughflow.

For this purpose, the method of the type mentioned above according to the invention is characterized in that, prior to being caused to grow, the initial skeleton is such that or is arranged so that, during the growth, the flow through the initial skeleton is locally blocked.

The method according to the invention is based on the insight that, if the flow of bath liquid through the initial skeleton is not possible at certain locations or in certain areas during the further growth of the initial skeleton, the metal will deposit precisely at said locations or in said regions on the growth side of the

initial skeleton because a "shelter" is present in the liquid flow there. In those regions, the metal deposition will therefore take place much more quickly than on the dykes of the initial skeleton, over which the bath liquid flows unimpeded. In the method according to the invention, it is therefore important that the liquid flow is or has been locally blocked.

In order to block the liquid flow locally, either an initial skeleton can be used in which measures have already been taken in the skeleton itself to form such "shelter" locations during the electroforming, or additional blocking measures can be taken which are not associated with the skeleton itself, so that such "shelter" locations are created during the electroforming.

Preferably, an initial skeleton is used, in which screen patterns of openings separated by dykes are separated from one another by a supporting grid of reinforcing webs (metal paths or tracks) whose width is greater than the width of the dykes of the screen pattern.

In this embodiment of the method according to the invention, an initial skeleton is used which has been formed earlier, for example, by means of electroforming. This preformed skeleton comprises, in addition to the dykes of the screen pattern which separate the openings, relatively wide supporting or reinforcing webs which separate such screen pattern regions and which provide the desired strength in the finished product. During the performance of the method according to the invention using such an initial skeleton, the metal deposition takes place essentially on the wide supporting or reinforcing webs and not on the dykes of the screen pattern.

The electroplating process used in the method according to the invention is already known per se from a number of previous patent publications (see, for example, EP-B1-0 038 104, EP-B1-0 049 022 and EP-B1-0 492 731.

The method known from EP-B1-0 038 104, of electrolytically manufacturing a screen product comprises the deposition of metal on the skeleton in an electrolytic bath which comprises at least one organic compound having at

least one unsaturated bond not associated with a =C-S=O group. In this way, the growth of metal is promoted perpendicularly to the surface of the screen skeleton. Examples of such agents are butyndiol and ethylene cyanohydrin.

In the method according to EP-B1-0 049 022, a forced flow of bath liquid of at least 0.005 m/s through the openings of the skeleton is applied, at least during a part of the electrolytic metal deposition.

In the method according to EP-B1-0 492 731, a compound having properties of first-class and second-class brighteners is used in a concentration which is such, in relation to the Ah load, that the internal stress of the finished product decreases. Such compounds having properties of both the first-class and second-class of brighteners are advantageously used in the method according to the invention. An example thereof is PPS-OH.

All three patent specifications discussed above disclose selective growth methods, but they do not suggest a method in which the liquid flow is locally blocked, for example by using a skeleton in which dykes having different widths are present.

Such an initial skeleton which is used in the method according to the invention can be obtained, for example, by providing a matrix with wide solid conducting webs in addition to the standard screen pattern. The skeleton is then manufactured electrolytically. Said skeleton is removed from the matrix and then subjected to electroplating according to the invention.

Aside, it is pointed out that US Patent Specification 4 844 778 discloses a membrane and also a manufacturing method therefor, in which a thicker edge may be present in the finished product than in the rest of the product. Said edge also serves as reinforcement. The method described therein is a photolithographic method which comprises a plurality of steps, 2 patterns having to be accurately positioned on top of one another.

In another preferred embodiment of the method according to the invention, local flow-blocking means are

provided at least on the incident-flow side of the initial skeleton prior to causing the initial skeleton to grow further. Suitable means thereof comprise, for example, photoresist webs or a grid of nonconducting material, such as a plastic.

The shape of the supporting grid in the initial skeleton and the pattern of the photoresist webs or the shape of the plastic grid are not critical. Of course, if a photoresist and the like is used, the metal of the initial skeleton must not be covered on the growth side because the desired metal growth cannot otherwise occur.

As has already been stated above, it has been found, surprisingly, that, in the method according to the invention, growth of metal essentially takes place only at the "shelter" locations, for example the wide reinforcing webs of the supporting grid, and not on the dykes of the screen pattern. The finished screen product consequently comprises screen pattern regions having lower thickness than the thickness of the webs of the supporting grid. In this way, a screen product is obtained which has high strength, high mesh value as well as high throughflow. If an electroformed screen product is used as filter, the mesh value is generally in the region of 10-4000 mesh, the dimensions of the openings being in the region of 1-20 micrometres. That is to say, screens having a high fineness and small openings with adequate strength can be manufactured so that the screen products are suitable for industrial applications. Because of the low thickness, the screen product has a low resistance, which implies a low pressure drop and a high flux.

Preferably, the ratio of the width of the dykes of the screen pattern to the width of the reinforcing webs is in the region of 1:2 to 1:10. It has been found that such a ratio is favourable for the different growth on the relatively wide webs of the supporting grid rather than on the dykes of the skeleton. The abovementioned ratio also applies t o the other embodiments of the method according to the invention in which the initial skeleton is locally covered, for example, by photoresist webs or has been

screened, for example, by a plastic mask.

Advantageously, a flow of bath liquid through the skeleton connected as cathode is maintained during the performance of the method. The electrolytic bath may comprise the specific components, in particular brighteners, such as those described in the abovementioned Patent Specifications EP-B1-0 038 104, EP-B1-0 049 022 and EP-B1-0 492 731.

The invention furthermore relates to an initial skeleton for use in the method according to the invention. Such a skeleton comprises regions having a pattern of openings separated by dykes, which regions are separated from one another by a grid of reinforcing webs whose width is greater than the width of the dykes of the screen pattern.

The invention also relates to an electroformed product which comprises such a skeleton or which has been manufactured by the method according to the invention. The presence of the skeleton and the presence of the reinforcing webs in addition to the presence of "standard" product dykes in the final product are characteristic of the final product.

The invention will be explained in greater detail below by reference to the accompanying drawing, wherein:

Figure 1 is a diagrammatic plan view of a screen product which has been manufactured with the aid of an embodiment of the method according to the invention; and

Figure 2 is a partial cross section of the screen product shown in Figure 1.

Figure 1 shows a nickel screen product which has been manufactured according to an embodiment of the method according to the invention. The screen product 1 comprises a number of screen patterns 2 which are separated by a supporting grid 3 of relatively wide reinforcing webs 4. The patterns 2 comprise openings 5 which are separated by relatively narrow dykes 6. The wide reinforcing webs 4 provide the product 1 with the required strength.

As it appears from Figure 2, an enlarged diagrammatic cross section of a screen product obtained by

the method according to the invention, the wide reinforcing webs 4 have a greater thickness than the dykes 6. In this figure, the original skeleton, which forms part of the finished product, is indicated by reference numeral 7 and shown hatched.

The invention is further explained by reference to the following examples.

An initial skeleton having the characteristics stated in the table below is placed in a nickel sulphamate bath containing a compound having properties of first-class and second-class brighteners, for example PPS-OH, and is then grown. The screen pattern used has a round grid in triangular bracing and having a mesh number of 570 (570 mesh). The supporting grid is a square grid having a mesh number of 17.

TABLE 1. 570 MESH

VARIABLE	SKELETON	GROWTH
THROUGHFLOW (THEOR.)	8.7%	3.7%
SCREEN GRID THICKNESS (μm)	16	27
SUPPORTING GRID THICKNESS (μm)	67	303
HOLE SIZE (μm)	14	11
SUPPORTING-GRID DYKE WIDTH (μm)	305	403

In a comparable way, products having mesh numbers of 850 (850 mesh) and 1016 (1016 mesh) were manufactured. 850 Mesh also has a round grid in triangular bracing. 1016 Mesh has a square grid. The supporting grids were identical to that of the above 570 mesh example. Tables 2 and 3 report the data of the initial skeleton and the product obtained.

TABLE 2. 850 MESH

VARIABLE	SKELETON	GROWTH
THROUGHFLOW (THEOR.)	8.8%	4.3%
SCREEN GRID THICKNESS (μm)	15	24
SUPPORTING GRID THICKNESS (μm)	71	271
HOLE SIZE (μm)	9	6.5
SUPPORTING-GRID DYKE WIDTH (μm)	294	398

TABLE 2. 1016 MESH

VARIABLE	SKELETON	GROWTH
THROUGHFLOW (THEOR.)	10.8%	3.5%
SCREEN GRID THICKNESS (μm)	11.5	22
SUPPORTING GRID THICKNESS (μm)	68	316
HOLE SIZE (μm)	8	5
SUPPORTING-GRID DYKE WIDTH (μm)	299	398

It is pointed out that the method according to the invention is suitable both for manufacturing flat screen products and for manufacturing cylindrical screen products.

The method according to the invention can be advantageously coupled to a method of switched electroforming by which a skeleton having reinforcing webs with greater thickness than the dykes of the screen pattern can be obtained in just one step. Said skeleton can then be reinforced further with the aid of the method according to the invention.

In the method of switched electroforming, a matrix is used having a first grid of electrically conducting webs, which grid is electrically insulated from a second grid of conducting webs. In electroforming using said matrix, the first grid is first connected to a current source and metal deposition takes place on said grid. With the lapse of time, said metal deposition brings about an electrical connection with the second grid by lateral overgrowth, after which, if the electroforming is continued further, metal deposition will occur on both grids. Since metal deposition takes place longer on the first grid than on the second grid in this method, the metal deposits on the two grids have a different thickness. A suitable skeleton which already comprises relatively wide and thick

webs compared to the other metal deposits and which can be advantageously used in the method according to the invention as initial skeleton can thus be formed by a suitable design of the grids.

CLAIMS

1. Method of manufacturing a screen product (1) having a screen pattern (2) of openings (5) separated by dykes (6) by causing a previously formed, electrically conducting initial skeleton (7) to grow by means of metal deposition in an electrolysis bath containing a brightener, with exposure of the initial skeleton (7) to incident flow, characterized in that, prior to being caused to grow, the initial skeleton (7) is such that or is arranged so that, during the growth, the flow through the initial skeleton is locally blocked.

2. Method according to claim 1, characterized in that a screen skeleton (7) is used, in which screen patterns (2) of openings separated by dykes (6) are separated from one another by a supporting grid (3) of reinforcing webs (4) whose width is greater than the width of the dykes (6) of the screen pattern (2).

3. Method according to claim 2, characterized in that the ratio of the width of the dykes (6) of the screen pattern (2) to the width of the reinforcing webs (4) of the supporting grid (3) is in the region of 1:2 to 1:10.

4. Method according to one of the preceding claims 1-3, characterized in that, while the previously formed, electrically conducting initial skeleton (7) is being caused to grow, a flow of the bath liquid through the openings (5) is maintained.

5. Method according to claim 1, characterized in that local flow-blocking means have been provided at least on the incident-flow side of the initial skeleton (7) prior to causing the initial skeleton to grow further.

6. Method according to claim 5, characterized in that the local flow-blocking means comprise photoresist webs or a grid of a nonconducting material.

7. Initial skeleton for use in the method according to one of the preceding claims 1-4, characterized in that the skeleton (7) comprises regions having a screen pattern (2) of openings separated by dykes (6), which regions are separated from one another by a supporting grid (3) of reinforcing webs (4) whose width is greater than the width

of the dykes (6) of the screen pattern (2).

8. Electroformed product which comprises a skeleton according to claim 7.

9. Electroformed product which has been manufactured by the method according to one of claims 1-6.

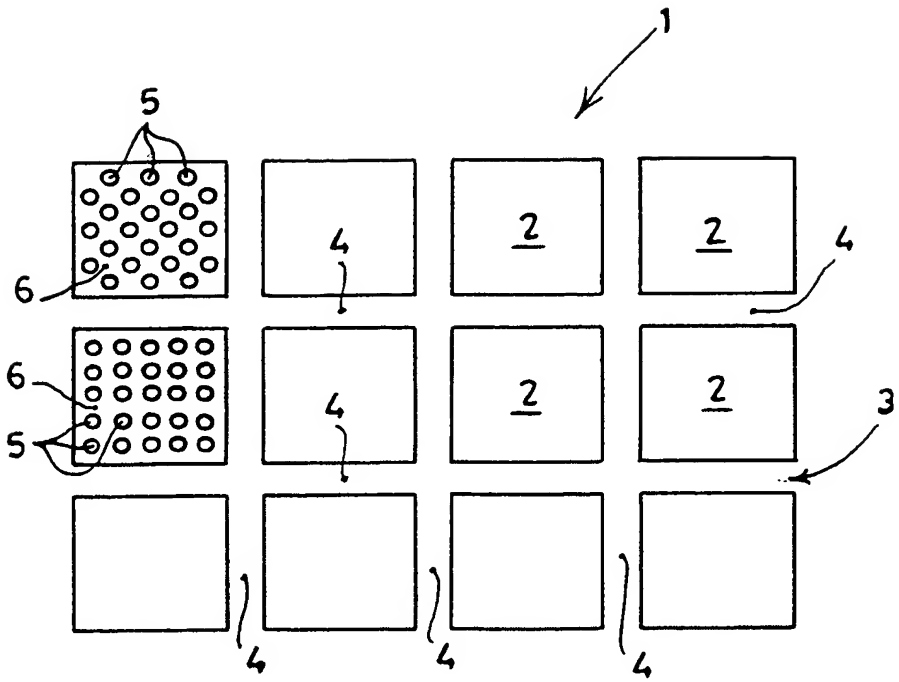

Fig. 1.

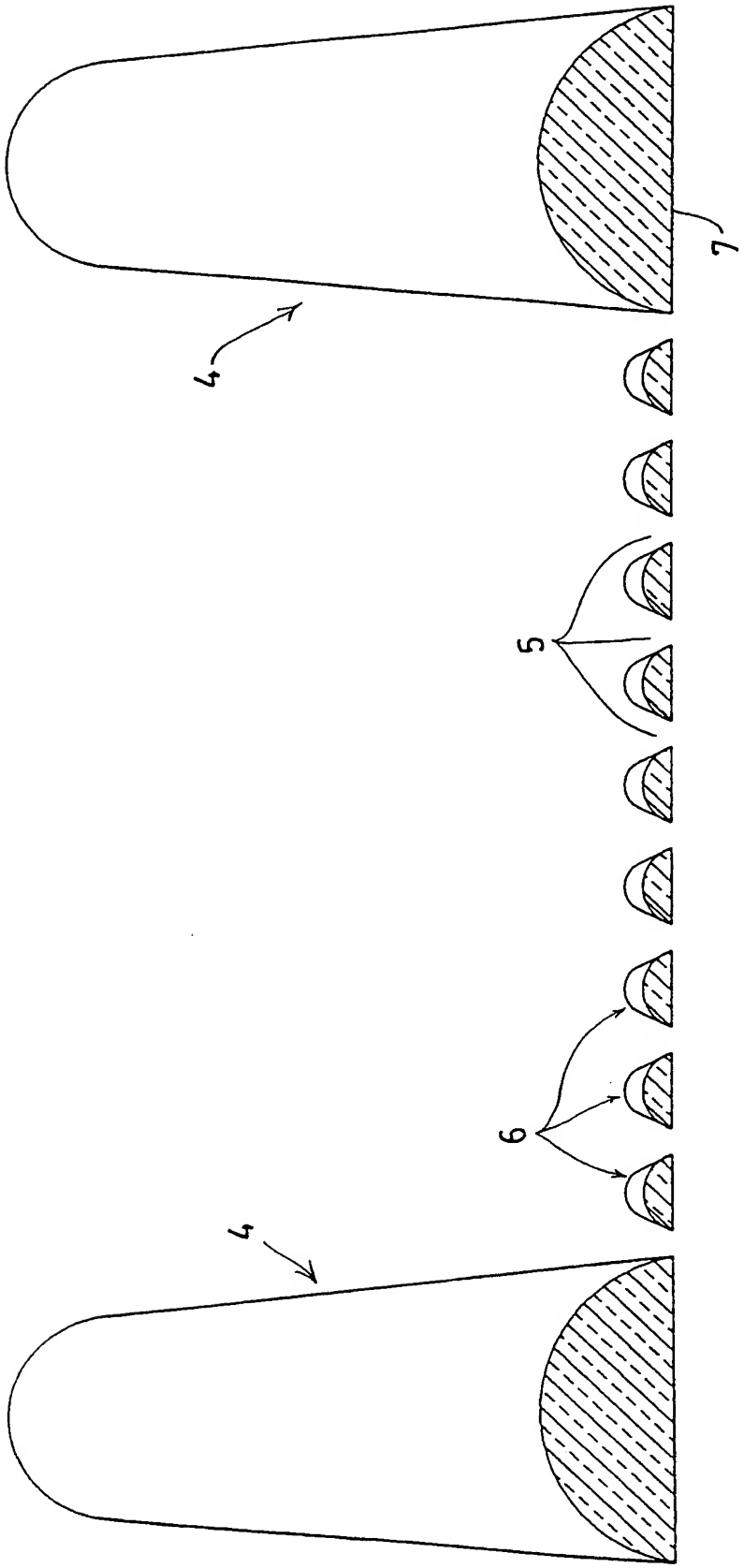

Fig. 2.

INTERNATIONAL SEARCH REPORT

[redacted] national Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C25D1/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 038 104 A (STORK SCREENS BV) 21 October 1981 cited in the application	
A,P	WO 97 40213 A (STORK VECO BV ;AQUAMARIJN MICRO FILTRATION B (NL); KNOL HARM GERRI) 30 October 1997	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Name and mailing address of the ISA	Authorized officer
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